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AN EVALUATION OF THE ANDEAN CONDOR POPULATION IN NORTHERN ECUADOR

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Abstract.—We evaluated the population structure of Andean Condors (*Vultur gryphus*) in the Cotacachi-Cayapas and Cayambe-Coca Ecological Reserves, Ecuador. We conducted 1298 hr of fieldwork and made 496 condor observations. Age class and sex could be determined in 127 and 48 observations, respectively. The population consisted of 1:1 female to male ratio yet only 20% of our observations were of juveniles and subadults. The apparent skewed population structure suggested that the population may be declining.

Key Words: *Andean Condor,* Vultur gryphus; *paramo; Ecuador, population structure, vulture.*

Evaluacion de la población del cóndor andino en el norte del Ecuador

Resumen.—Evaluamos la estructura de población del cóndor andino (*Vultur gryphus*) en las reservas ecológicas de Cotacachi-Cayapas y Cayambe-Coca, Ecuador. LLevamos a cabo un estudio de campo de 1298 horas e hicimos 496 observaciones de condor. Las clases por edad y sexo pudieron ser determinadas en 127 y 48 observaciones, respectivamente. La población consistió de 1:1 entre machos y hembras, tan sólo el 20% de las observaciones fueron juveniles y subadultos. La aparentemente sesgada estructura poblacional sugiere que la población puede estar declinando.

[Traducción de César Márquez]

The Andean Condor (*Vultur gryphus*) ranged historically from Venezuela to Tierra del Fuego (Murphy 1936). Its present range is greatly reduced (McGahan 1972, Lieberman et al. 1993) and the Andean Condor is now listed as Endangered over its entire range due to its precipitous decline (U.S. Fish and Wildlife Service 1986) and considered critically imperiled in Ecuador (Granizo et al. 1997). In Ecuador, condors inhabit the paramos above 3000 m (Josse and Anhalzar 1996). Carrion consisting of wild and domestic ungulates make up their primary diet (McGahan 1972). Given the patchy distribution of their food resource, group foraging behavior increases the probability of locating food over individual searching by lone birds (Wallace and Temple 1988a).

The paramo habitat is under heavy human pressures from agriculture, intensive livestock management and tourism (Caberle et al. 1989, Luteyn 1992). Numerous condors have been found dead in recent years but a systematic population study has not been conducted. This study was undertaken to evaluate the Andean Condor population in northern Ecuador.

Study Area and Methods

We conducted fieldwork from August 1996–March 1998 in the paramos above 3000 m of the Cotacachi-Cayapas Ecological Reserve (CCER; 0°25′N, 78°20′W) and the Cayambe-Coca Ecological Reserve (CAER; 0°08′N, 78°00′W) (Fig. 1). Additionally, we conducted fieldwork at Lake Mojanda, a proposed protected area (0°08′N, 78°17W). All areas lie in northern Ecuador. The CCER is within the western cordillera of Imbabura Province and the CAER is in the eastern cordillera of Pichincha Province. Lake Mojanda lies between the cordilleras.

Paramo is an equatorial alpine grassland ecosystem dominated by bunchgrasses (*Festuca* spp.) and characterized by shrubs (*Polylepis incana, Brachyotum alpinum, B.*

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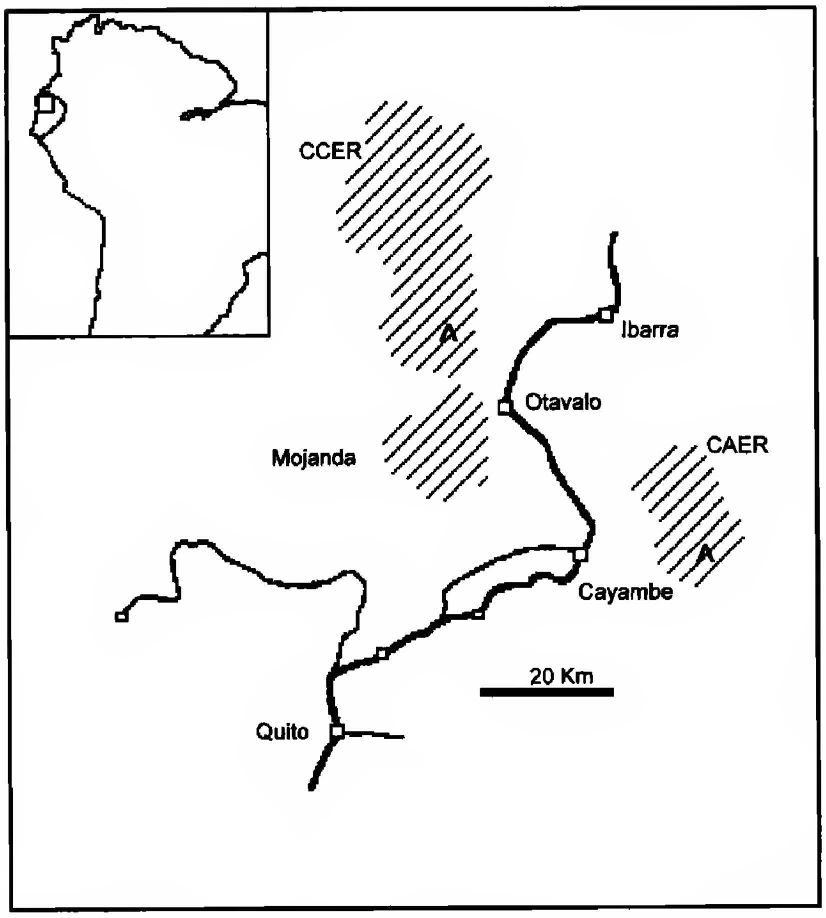

Figure 1. Approximate area (shaded) covered by condor surveys in 1996–98 in the Cotacachi-Cayapas Ecological Reserve (CCER), Cayambe-Coca Ecological Reserve (CAER) and Lake Mojanda area, Ecuador.

ledifolium, Chuquiraga jussieui), ground level plants (*Huperzia crassa, Valeriana rigida, Lupinus* sp.) and giant rosette-plants (*Puya* spp.) (Luteyn et al. 1992, Josse and Anhalzar 1996). The paramos cover approximately 25 000 ha (Josse and Anhalzer 1996), or roughly a little over 2% of Ecuador's landcover. Mean temperature is 8°C and total annual rainfall ranges from 900–2600 mm (Josse and Anhalzar 1996).

Surveys were conducted on week-long trips to the study areas. Day-long surveys were made from 19 ridgetops that were identified as condor viewing areas by park rangers and local residents who knew the study areas well. Ten of these ridgetops were located in CCER and known locally as: La Cienega, Pulumbura, El Campanario, Hacienda Chinchivi, Cerro Pilabo, Cerro Nagñaro, Cerro Quilili, Pantavi Grande, Pantavi Chico and Las Antenas. Eight sites were used in CAER: Rasochupa, Turupamba Chico, Turupamba Grande, Quebrada de Mirlos, Quebrada Chimborazo, Ancholas, La Dormida and El Verde. In addition, the area adjacent to Lake Mojanda was used.

Fieldwork was generally conducted during the day between dawn and dusk. Any surveys made while traveling through paramo by horse, foot, four-wheel-drive vehicles, or when stationary were counted toward hours in the field except during heavy rains when condors were less likely to be observed. All observations were made using 8× and 10× binoculars and 20–60× spotting scopes. Photographs of condors were taken with 280 mm and 500 mm lenses when possible from 13 August 1996–22 January 1997.

We distinguished individual condors based on feather wear and molt patterns and identified sex when possible (Snyder and Johnson 1985). We noted condor behavior for evidence of breeding status (McGahan 1972, Palmer 1988). Condors were grouped into adult (≥8 yr old) and immature (<8 yr old) age classes based on plumage characteristics described by McGahan (1972). We assumed that different age groups and sexes had equal chances of being observed in the field.

RESULTS

We spent 1298 hr in the field and made 496 condor observations from 19 ridgetops. Of these observations, 298 condor sightings were in the CCER, 186 in the CAER and 12 at Lake Mojanda. For each hour spent in the field, we were able to make 1.3 min of condor observations. We were able to determine the sex in 48 observations and estimate the condor's age in 127 observations. Our sample revealed a male to female ratio of 1:1. Adults comprised 80% of condors aged giving us a 4:1 ratio of adults to immatures. The maximum number of condors simultaneously in view was eight birds in the CCER. We were able to identify at least seven adult and four immature condors for all study sites based on a comparison of feather characteristics and molt patterns.

One nest was reported to us in May 1996 and was situated 100 m above an active tunnel construction site adjacent to the CAER (INEFAN 1997). A second pair of adult condors was seen copulating in September 1997 near Lake Cuicocha of the CCER. The pair was seen repeatedly in the area through March 1998 but no nest was located. We found no signs of additional breeding pairs.

DISCUSSION

The results of our study suggested Andean Condors may be undergoing a population decline in northern Ecuador. Temple and Wallace (1989) determined in Peru that Andean Condors >6 yr old had a 94% survival rate. Independent juvenile condors between 1–6 yr old had a 90% survival rate, whereas dependent juvenile condors <1 yr old had a 74% survival rate. Breeding once every 3 yr is required to maintain a stable population. Wallace and Temple (1988b) calculated that a 1:1 ratio of adult to juvenile indicated a population with pairs that were breeding about once every 2 yr. The adult male to female ratio (1:1) found in our study suggested that pairing should occur. However, the 4:1 ratio of adult to immature suggested that the population was declining because the adult cohort was not being replaced.

This skewed age structure in the population may be the result of high mortality. Five Andean Condors were reported dead in 1987 by Cayambe residents. INEFAN park rangers also reported six dead condors near the Antisana Ecological Reserve in 1988. Five more were found killed by unknown factors in CCER in the early 1990s. Causes of mortality were not reported. One condor, however, was reportedly killed by Compound 1080 in 1990 and a car collision was suspected as the cause of a mortality in 1996 (L. Martinez pers. comm.). Whereas we expected that immatures had a much higher mortality rate than adults (Wallace and Temple 1988b), we were unable to determine the degree that mortality factors affected the immature condor population in Ecuador. Given the low probability of finding or reporting dead condors, it was likely that these incidents represented a small fraction of the condors that presumably died since 1987.

The skewed age structure of this population might also have been due to the fact that these condors were not breeding at their full potential. We found no evidence of breeding pairs except for one nest and several copulation attempts by another pair of condors. Wallace and Temple (1988b) suggested that condors with food stress do not breed regularly. While food shortages were not implicated with the California Condor (*Gymnogyps californianus*) population decline (Johnson et al. 1983, Ogden 1985, Snyder and Snyder 1989), food availability shaped the condors' distribution patterns (Wilbur 1977). In Peru, Temple and Wallace (1983), found that 26% of released juvenile Andean Condors died of disease, starvation or unknown causes. The effect of food stress on the population in our study area was unknown.

Some factors associated with the California Condor decline have not yet been noted in Ecuador. Ogden (1985) and Wallace (1989), for example, reported that human disturbance around California Condor nests can be problematic. While evidence of human impact on Andean Condors is limited, we found that one young fledged successfully from a nest situated 100 m above a noisy construction site (INEFAN 1997). While this may have been an exceptional occurrence, it suggests that human disturbance to nesting condors may be tolerated.

High mortality rates or low reproductive rates will lead to a population that can only be sustained by immigration. Survival rates and reproductive rates of the condor population in Ecuador are not known at present. We do know, however, that immigration occurs because at least two adult condors in the Cayambe-Coca Ecological Reserve were tagged with patagial markers and released in Colombia from captive reared stock (Lieberman et al. 1993).

It should be noted that our results may also be artifacts of a skewed or small sample. Although we assumed that both sexes and all age classes had equal chances of being observed in the field, this may not have been the case. Given its distinctive head shape, for example, adult males may be easier to identify than females, especially at a distance. We were able to positively identify the sex of only 10% of our observations leaving us a relatively small sample size. Behavioral differences between adult and immature condors may explain also some of the skewed age ratio. Daily activity patterns among California Condors, for example, were unpredictable (Wilbur 1980). Snyder and Johnson (1985) noted that movement patterns among California Condors were divided among breeding territories and foraging areas. Adults stayed close to their respective breeding areas while all age groups appeared to mix thoroughly in foraging areas (Snyder and Snyder 1989). If Andean Condors had similar behavior to California Condors and our observation sites were limited to breeding territories, then we would expect to see few juveniles. Although we attempted to address this issue by conducting studies at 19 sites, surveys at additional foraging areas may contribute additional results.

The current Andean Condor population of northern Ecuador is small and critically imperiled (Granizo et al. 1997). Further field studies are needed to determine the causes of condor mortality, the effect of food shortages on the population and to develop and implement a successful management plan. Ecuador's human population is expected to double in 28 yr (Caberle et al. 1989) and condor habitat will likely diminish greatly as people move higher into the paramos where condors live.

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LITERATURE CITED

CABERLE, B.J., M. CRESPI, C. DODSON, C. LUZURIAGA, D. ROSSE AND J. SHORES. 1989. An assessment of biological diversity and tropical forests for Ecuador. Center for International Development and Environment of World Resources Institute, Washington, DC U.S.A.

GRANIZO, T., M. GUERRERO, C. PACHECO, R. PHILLIPS, M.B. RIBADENEIRA AND L. SUÁREZ. 1997. Lista de aves amenazadas de extinción en el Ecuador. UICN-Sur, CECIA, INEFAN, EcoCiencia and Birdlife International. Quito, Ecuador.

INEFAN. 1997. Los cóndores de Papallacta. INEFAN. Quito, Ecuador.

JOHNSON, E.V., D.L. AULMAN, D.A. CLENDENEN, G. GULIASI, L.M. MORTON, P.I. PRINCIPE AND G.M. WEGENER. 1983. California Condor: activity patterns and age composition in a foraging area. *Am. Birds* 37:941–945.

JOSSE, C.M. AND J. ANHALZER. 1996. A guide for the paramos of the Ecuadorian national protected areas system. Instituto Ecuatoriano Forestal y de Areas Naturales y Vida Silvestre—INEFAN. Quito, Ecuador.

LIEBERMAN, A., J.V. RODRIQUEZ, J.M. PAEZ AND J. WILEY. 1993. The reintroduction of the Andean Condor into Colombia, South America: 1989–1991. *Oryx* 27:83–90.

LUTEYN, J.L. 1992. Páramos: why study them? Pages 1–14 *in* H. Balslev and J.L. Luteyn [EDS.], Páramo: an Andean ecosystem under human influence. Academic Press, New York, NY U.S.A.

———, A.M. CLEEF AND O. RANGEL. 1992. Plant diversity in páramo: towards a checklist of páramo plants and a generic flora. Pages 71–84 *in* H. Balslev and J.L. Luteyn [EDS.], Páramo: an Andean ecosystem under human influence. Academic Press, New York, NY U.S.A.

MCGAHAN, J. 1972. The behavior and ecology of the Andean Condor. Ph.D. dissertation, Univ. Wisconsin, Madison, WI U.S.A.

MURPHY, R.C. 1936. Oceanic birds of South America. American Museum of Natural History, New York, NY U.S.A.

OGDEN, J. 1985. The California Condor. Pages 388–399 *in* R.L. Di Silvestro [ED.], Audubon wildlife report 1985. Natl. Audubon Soc., New York, NY U.S.A.

PALMER, R.S. 1988. Handbook of North American birds. Vol. 4. Yale Univ. Press, New Haven, CT U.S.A.

SNYDER, N.F.R. AND E.R. JOHNSON. 1985. Photographic censusing of the 1982–1983 California Condor population. *Condor* 87:1–13.

——— AND H.A. SNYDER. 1989. Biology and conservation of the California Condor. Pages 175–267 *in* D.M. Power [ED.], Condor biology and conservation. Current Ornithol. 6. Plenum Press, New York, NY U.S.A.

TEMPLE, S.A. AND M.P. WALLACE. 1983. A study of techniques for releasing hand-reared Andean Condors to the wild: final report on contract FWS 14-16-009-78-923. Dept. Wildlife Ecology, Univ. Wisconsin–Madison, Madison, WI U.S.A.

——— AND ———. 1989. Survivorship patterns in a population of Andean Condors (*Vultur gryphus*). Pages 247–251 *in* B-U. Meyburg and R.D. Chancellor [EDS.], Raptors in the modern world. WWGBP, Berlin, Germany.

U.S. FISH AND WILDLIFE SERVICE. 1986. Endangered and threatened wildlife and plants. USDI, U.S. Fish and Wildlife Service. Washington, DC U.S.A.

WALLACE, M.P. 1989. Andean Condor experimental releases to enhance California Condor recovery. *Endangered Species Update* 6:1–4.

——— AND S.A. TEMPLE. 1988a. A comparison between raptor and vulture hacking techniques. Pages 75–81 *in* D.K. Garcelon and G.W. Roemer [EDS.], Proceedings of the international symposium on raptor reintroduction, 1985. Inst. for Wildlife Studies, Arcata, CA U.S.A.

——— AND ———. 1988b. Impacts of the 1982–1983 El Niño on population dynamics of Andean Condors in Peru. *Biotropica* 20:144–150.

WILBUR, S. 1977. Supplemental feeding of California Condors. Pages 134–140 *in* S.A. Temple [ED.], Management techniques for preserving threatened species. Univ. Wisconsin Press, Madison, WI U.S.A.

———. 1980. Estimating the size and trend of the California Condor population, 1965–1978. *Calif. Fish and Game* 66:40–48.

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